Slant Stacks and Diffracted Multiples

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In considering application of Don C. Riley's diffracted multiple reflection techniques to field data, we encountered several practical barriers. The theory can be applied individually to separate profiles, but this is too cumbersome and costly to inspire present implementation. The theory can also be applied to vertical stacks. To see why this is so, consider the upcoming wave equation

$$U_{tz} = -U_{gg} + c(g,z)\, D_t \tag{1}$$

where the up and downgoing waves U and D are functions of geophone horizontal coordinate g, geophone depth coordinate z, time t, and the surface shot horizontal coordinate s. Note that (1) could be thought of as a separate problem for each numerical choice of s. Now let us sum equation (1) over s. We can commute the operations of summation and partial differentiation obtaining

$$\partial_{tz} \sum_s U = -\partial_{gg} \sum_s U + c(g,z) \sum_s D \tag{2}$$

Defining vertically stacked sections by

$$U'(g,t,z) = \sum_s U(g,s,t,z) \tag{3a}$$

$$D'(g,t,z) = \sum_s D(g,s,t,z) \tag{3b}$$

Equation (2) now becomes the equation for vertically stacked sections

$$U'_{tz} = -U'_{gg} + c(g,z)\, D'_t \tag{4}$$